Instruction Manual
for the

NATIONAL
1-10 RECEIVER

An improved super-regenerative receiver covering all wavelengths from one to eleven meters

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Price 10c

THE enormous frequency range covered by the wavelengths between one and ten meters was, until a year or so ago, practically unused. The value of this territory is rapidly increasing, however, as evidenced by the activity of amateurs, the efficiency of the two-way police radio, the advent of the new high fidelity broadcasts, and facsimile transmission, not to mention experimental television.

The experimenter has been seriously handicapped by lack of a suitable receiver. The 1–10 receiver has been designed to best fulfill this need, with due regard for the special characteristics of present day transmitters, and has been made extremely sensitive, but at the same time very simple and easy to operate.

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The 1-10
Ultra High Frequency Receiver

Tubes and Power Supply

THE Type "1-10" receiver employs a 4-tube circuit, consisting of one stage of tuned R.F., a self-quenching superregenerative detector, transformer coupled to a first stage of audio which, in turn, is resistance coupled to a power output stage.

The tubes employed are as follows:

954 — R.F.
955 — Detector
6C5 — First Audio
6F6 — Second Audio

The receiver is designed for operation from the National Type No. 5886 AB power unit, all voltage dividers, etc., being built in so that but one B-voltage lead is necessary. This power supply furnishes six volts at 1.6 amperes to the heater circuit and 180 volts at 35 milliamperes to the plate and screen circuits. If desired, the heaters may be supplied from a 6-volt battery and the B-circuits from B-batteries. Voltages in excess of 180 are not recommended and receiver performance will be unsatisfactory on the "A" range at voltages below 167. If lower voltages must be used, as in portable operation, the 20,000 ohm resistor connected between the B+ lead and the regeneration control and the 35,000 ohm screen dropping resistor of the R.F. stage, may both be shorted out. This will allow the receiver to function normally with a maximum voltage of 90, but with reduced audio output. A 3-volt C-battery is used to supply bias to the R.F. tube. This battery is mounted in the rear righthand corner of the R.F. compartment, being held in place by a spring clip. Two Eveready Type 915 cells, or equivalent, are needed. They are mounted in a bakelite tube and the positive (center) terminal of the upper cell is grounded at the top by a retaining bracket.

Antenna

The importance of an efficient antenna cannot be over emphasized. The antenna lead, or leads, should be brought directly to the antenna binding posts at the top of the receiver. They may be threaded through the hole in the cover and arranged so that the cover may be opened for changing coils.

A small flexible lead will be found connected to the front antenna post. This supplies a ground connection where a single-wire antenna is used. It should be disconnected from the binding post when doublet feeders or two-wire lines are employed. An external ground connection is usually undesirable, but this point must be determined by experiment.

While the antenna primaries are of symmetrical construction, mechanical considerations prevent exact balance to ground, and there is some capacity coupling between the windings, especially at the higher frequencies.

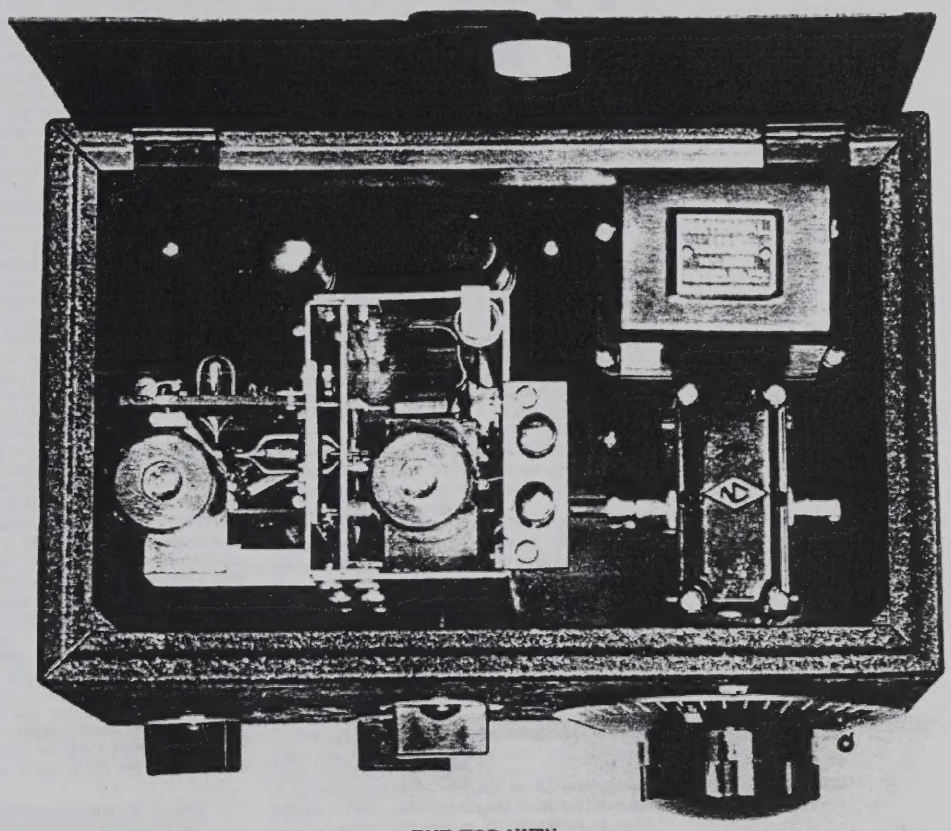
Exact recommendations for antenna systems cannot be given, since the dimensions will depend upon the frequency at which best efficiency is desired, directional characteristics, etc. In general, however, the antenna proper should be tuned to the received signal. In many installations this condition may be satisfactorily realized by tuning the feeders with series or parallel condensers. The size of the tuning condensers will depend upon the frequency of the received signal and upon antenna dimensions. The transmission line must be efficient. As a rule, "twisted pair", or similar lines, are not satisfactory at frequencies much above 40 or 50 mc., especially where the length exceeds a full wavelength. The open wire or transposed line is much better.

Another general rule regarding antennae, is that any system which is found to be efficient in transmission will have good efficiency with the same directional characteristics, etc., in reception.

Output Circuit and Speaker

The plate circuit of the output tube is brought to the output jack, located at the rear lefthand side. There is no output transformer in the receiver. The speaker requirements are not at all critical, any good magnetic or dynamic speaker being satisfactory provided the input impedance is approximately 7000 ohms, and provided the speaker windings are capable of carrying the plate current of the output tube (about 25 ma.). Some magnetic speakers will require a filter system, such as a 1 to 1 transformer or a 30 henry choke and 1. mfd. condenser combination. There is no provision for the field excitation of a dynamic speaker from the Type No. 5886 AB power unit. For this reason, the permanent magnet type of dynamic speaker is recommended, no field excitation being required.

The headphone jack is located on the front panel, just below and to the left of the main dial. This jack is wired into the output of the first audio stage in such a way that when the phones



THE TOP VIEW

Note the double-shielding between the R.F. and detector circuits, and the unique arrangement of parts.

are plugged in, the signal input to the last tube is completely disconnected. *It is important, however, that the plate circuit of the output tube be complete at all times.* If the speaker is to be disconnected, a jumper must be inserted in the tip-jacks to connect them together. The receiver should not be operated from the above mentioned power supply with the output tube removed, as the voltage might rise above 180 volts. When operated from batteries, the removal of the 6F6 is permissible and will give better battery economy.

Controls

The main dial is the tuning control; calibration curves for the various coils are shown on page 7. The curves are accurate to about three percent. It will be noted that frequency increases with dial reading.

The switch at the lower righthand corner breaks the positive B-supply lead and is useful for temporarily rendering the receiver inoperative during periods of transmission or when changing coils. When using B-battery plate supply, the switch should be thrown to the "Off" position at all times when the receiver is not in use, in order to avoid parasitic drain. No switch is provided for opening the heater circuit.

There are three small dials in addition to the main tuning dial. These control detector regeneration, audio gain, and the alignment of the R.F. circuit, and are marked accordingly.

Operating Characteristics

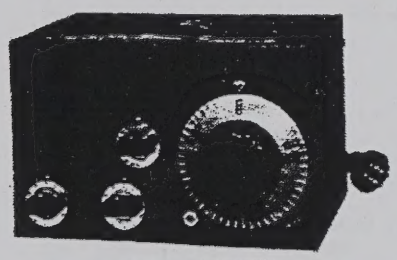
The "1-10" receiver is designed primarily for the experimenter and to this end has been made to have maximum sensitivity and a wide frequency range. The use of a self-quenching superregenerative detector with a stage of tuned R.F. provides excellent sensitivity and AVC action. Unfortunately, this type of detector introduces some distortion, since it does not have a linear characteristic. The distortion is small when signals are not modulated heavily, and increases with the percentage of modulation.

The various coils are stamped "A-1", "A-2", "B-1", "B-2", etc. They are used in pairs. The coil sockets of the R.F. and detector stages are marked "1", and "2", respectively, to correspond with the coil designations. The high frequency coils, (particularly the "A-1") must be pushed down in the socket as far as they will go. If they are not, the inductance of the primary and secondary circuits will be increased and the calibration of the circuit will be altered.

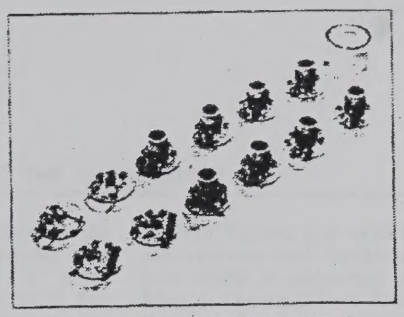
With any pair of coils in the receiver, the audio gain control should be advanced to 3 or 4 on the dial. Advancing the regeneration control will throw the detector circuits into superregeneration. This condition is indicated by a loud rushing or hissing noise. The hiss will drop down to a very low level or disappear entirely when a signal is tuned in, the reduction depending somewhat upon signal strength. The setting of the regeneration control at which the detector goes into superregeneration will vary with different sets of coils and with the condition of the 955 detector tube. On the "A" range it may be necessary to advance the control to the full on position as the detector tube begins to wear out. Sensitivity will depend upon the adjustment of the regeneration control, the maximum occurring just beyond the point where the hiss starts. The audio gain control must be used to control volume.

With the antenna disconnected and the detector just beyond the point at which superregeneration starts, rotation of the R.F. trimmer control will produce a definite decrease in the detector hiss at a certain setting, usually between 2 and 4. The R.F. circuit is aligned with the detector at the middle of this "dead spot". Advancing the regeneration control will start the hiss again. It is well for the operator to familiarize himself with the effect of these two controls as one is dependent upon the other.

The regeneration control has some tuning effect, increased plate voltage causing an increase in frequency. This necessitates re-tuning toward the lower dial numbers. The effect will vary with the coils employed and the dial setting. Similarly, the effect of the trimmer condenser will vary over the range of the receiver and also



THE 1-10 RECEIVER



THE COILS WITH COVERS REMOVED
From left to right, the coils are designated as A, B, C, etc. Detector coils are in front.

over the range of any one pair of coils. With any type of antenna connected, even a few inches of wire, the effect of the R.F. trimmer upon the detector circuit will be greatly reduced if not eliminated. It may still be found by operating the detector at the very edge of superregeneration. The trimmer setting is still critical with regard to the receiver sensitivity, however. The alignment of the trimmer will change with the dimensions of the antenna and also with the tuning of the receiver when using an antenna of fixed size. The setting which aligns the R.F. stage may move in either direction on the trimmer dial, depending upon antenna characteristics.

In determining the correct trimmer setting, when a signal is already tuned in, the operator should judge by the degree of hiss suppression, the maximum suppression indicating correct alignment.

It is important that the regeneration control be advanced sufficiently so that the detector is oscillating strongly. If it is not, any received signal will appear to have a series of carriers a few k.c. apart over several divisions of the tuning dial.

The operator who is not familiar with the PW type dial and tuning mechanism may gain the impression that the receiver tunes very broadly. A superregenerative receiver is, of course, less selective than other types used on lower frequencies but selectivity cannot be judged by the dial space covered by a given signal unless the total equivalent scale length is remembered. Since the dial makes ten revolutions to cover any one coil range, the scale length is approximately 12 feet.

Maintenance

There are no circuit adjustments or trimmer settings to be made, other than those which are brought out to the front panel and which have been previously discussed.

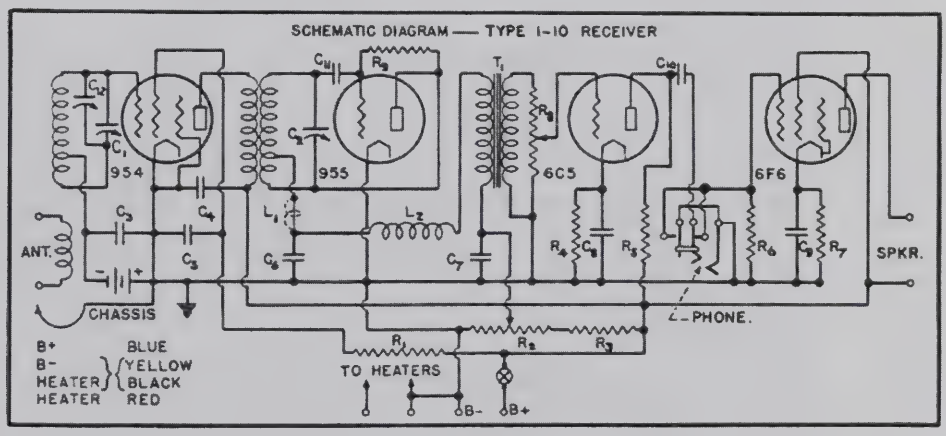
The effect of decreasing battery voltages (both A and B) and ageing tubes will first be noticed

when using the "A" coils, particularly at the extreme ends of the range. A 955 detector tube which will no longer operate on the "A" range will still give good performance at lower frequencies. Similarly, any poor connection at the tube socket or coil socket will be especially noticeable at the highest frequencies. In fact, the detector may refuse to go into superregeneration unless the coil contacts, etc., are perfectly clean.

It will be noted that the variable condenser supports, coil sockets, and coil bases, etc. are made of Victron, and while this material has exceptional electrical characteristics, it is similar to hard rubber in mechanical strength and its inability to withstand heat. The receiver should not, therefore, be subjected to high temperatures and the Victron parts must be handled with reasonable care to prevent breakage.

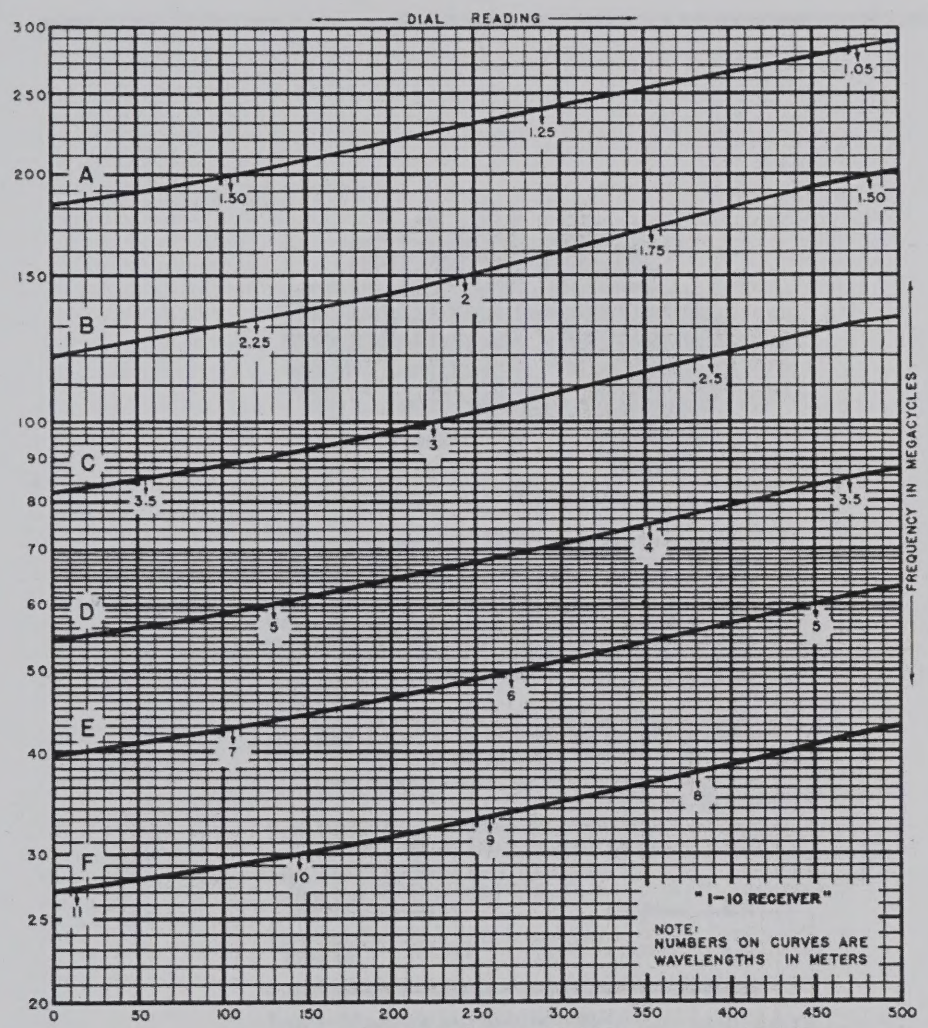
The C-battery does not supply any current and will require replacement but about once a year.

Additional coils for extending the range in either direction are not available.

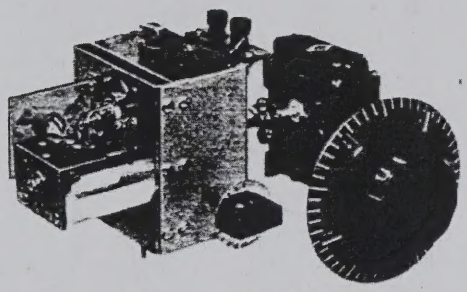


List of Parts

C_1	R.F. Tuning Condenser	15 mmf. max.
C_2	Detector Tuning Condenser	15 mmf. max.
C_3	R.F. Grid Return Bypass	.002 mfd.
C_4	R.F. Plate Return Bypass	.003 mfd.
C_5	Screen Bypass (copper plate)	.0005 mfd.
C_6	Quench Frequency Bypass	.003 mfd.
C_7	Detector B+ Bypass	.5 mfd. — 200 volt
C_8	1st Audio Cathode Bypass	10 mfd. — 50 volt
C_9	2nd Audio Cathode Bypass	10 mfd. — 50 volt
C_{10}	Audio Coupling Condenser	.1 mfd. — 400 volt
C_{11}	Detector Grid Condenser	.00005 mfd.
C_{12}	R.F. Trimmer Condenser	5 mmf. max.
R_1	Screen Dropping Resistor	35,000 ohms — ½ watt
R_2	Regeneration Control	50,000 ohm Potentiometer
R_3	Detector Plate Dropping Resistor	20,000 ohms — 1 watt
R_4	1st Audio Bias Resistor	5,000 ohms — ½ watt
R_5	1st Audio Plate Resistor	1 megohm — ½ watt
R_6	2nd Audio Grid Leak	.5 megohm — ½ watt
R_7	2nd Audio Bias Resistor	500 ohms — 1 watt
R_8	Audio Gain Control	500,000 ohm Potentiometer
R_9	Detector Grid Leak	20 megohms
L_1	Ultra-audion Choke — Used only on Higher Frequency Ranges	
L_2	Quench Frequency Choke	250 millihenries
T_1	Audio Transformer	4:1 Ratio



CALIBRATION CURVES



ULTRA H. F. TUNING UNIT

The new National High Frequency Tuning Unit is an ideal chassis for experimental work. The two-section Victron-insulated condenser carries the plug-in coils immediately above the stators, providing extremely short leads. Rotors are individually insulated, with very small capacity to ground. Standard capacity is 15 mmf. per section. Socket spring contacts and rotor contacts are heavily silver plated. The dial and drive unit is the National Type PW-O.

The Unit is used in the 1–10 receiver described in the preceding pages. It is suitable for superheterodyne, superregenerative or TRF circuits.

Type PWC, without acorn tubes or coils	List Price	$37.50
Type XRB Victron plug-in bases, with silver-plated contact prongs, per pair	List Price	$1.20
Type XR-3 Coil forms only, unwound (low-loss R-39) as used in C, D, E and F coils, each	List Price	$.30
Type XRC Victron coil cover (see Page 5)	List Price	$.50

Type 1–10 receiver with coils, but without tubes, speaker or power supply. Tubes can be furnished at standard prices	List Price	$65.00
Type 5886 Power Supply for above receiver, less tube	List Price	$26.50

Shipping weights: Receiver 16 lbs., Power Supply 17 lbs.

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